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SUBMERGENCE OF ROOTS FOR ALVEOLAR BONE PRESERVATION. I. ENDODON--ETC(U)

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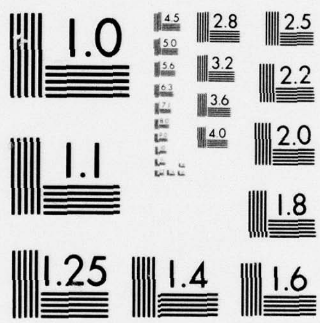
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SUBMERGENCE OF ROOTS FOR ALVEOLAR BONE PRESERVATION

I. ENDODONTICALLY TREATED ROOTS

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In conducting research described in this report, the investigators adhered to the "Guide for the Care and Use of Laboratory Animals," as promulgated by the Committee on the Revision of the Guide for Laboratory Animal Facilities and Care of the Institute of Laboratory Animal Resources, National Research Council.

ABSTRACT

Mandibular premolars in four mongrel dogs were endodontically treated, sectioned, reduced in situ so that each root was approximately 2 mm below the alveolus and totally submerged. Histologic and radiographic findings showed that this procedure should be used to preserve alveolar bone.

The alveolar ridge resorbs following tooth extraction whether or not it supports a prosthesis (1). Maintaining the alveolar ridge of complete denture patients has been a continuing major problem in dentistry and has stimulated research on the feasibility of retaining roots as a means of conserving the ridge (2).

Total submergence of tooth roots has been advocated in cases of advanced periodontal disease with considerable bone destruction, particularly for mandibular anterior teeth where no posterior teeth remain (3).

In the submergence procedure the crown is sectioned from the root at or below the level of the alveolar bone and the residual root is covered with a flap. Four methods of treating the remaining root have been reported in the literature.

1. Vitality is preserved in the residual root and submerged (4,5,6).
2. Pulpectomy is performed in the residual root and submerged without root canal therapy (7).
3. Residual root segment is treated endodontically and submerged. (8).
4. Endodontically treated root segment is intentionally replanted and submerged (9).

The most widely used method is to complete endodontic treatment prior to submerging the root.

The purpose of the present study is to investigate the biological response to roots that are endodontically treated and then submerged.

MATERIALS AND METHODS

Four healthy mongrel dogs were used, age ranging from two to five years and weighing approximately 40 pounds. The dogs were

premedicated with Innovar, 1cc per 20 pounds of body weight. Surgery was performed under general anesthesia using sodium pentothal, 1cc per 50 pounds of body weight, and nitrous oxide, 50% concentration.

The four mandibular premolars were used in this study with the single rooted first premolars serving as controls; sixteen roots of the remaining premolar teeth were selected at random to be used in this study. Both the control and the experimental teeth were treated endodontically. Following conventional preparation, the canals and pulp chambers were filled with gutta percha using the lateral condensation technique. Kerr Tubli-Seal* cement was utilized as the sealer.

A local anesthetic was administered (xylocaine 2% with 1/100,000 epinephrine) for hemorrhage control. Full thickness mucoperiosteal flaps were reflected on the buccal and lingual of the mandible. Inverse bevel incisions were used so creviculectomy could be accomplished. All excess soft tissue around the teeth was removed with curets. The first premolars received no treatment other than reflection of the flap.

The endodontically treated experimental teeth were sectioned and reduced in the mouth so that each root was approximately 2mm below the alveolus. This was accomplished using a diamond bur and water spray as a coolant.

*Kerr Sybron Corp., Romulus, Michigan

Releasing incisions were made in the periosteum at the base of the buccal flap. Primary closure was obtained using a mattress suture technique. Each animal received 600,000 units of benzathine penicillin G suspension and 600,000 units of Procaine G immediately after the procedure. Sutures were removed seven days postoperatively.

The animals were sacrificed in a sequence that provided two specimens and a control at the following postoperative times: 30, 40, 45, 55, 60, 90 and 120 days. This was done to determine the repair activity coronal to the submerged roots. Heparin was administered 30 minutes prior to each sacrifice. Under general anesthesia the animals were killed by perfusion with four liters of a 10% buffered solution of formalin through a cannula in the aorta. The mandible was removed in block and sectioned with one root per section. The sections were fixed in 10% buffered formalin, decalcified, embedded in paraffin, sectioned at 7-10 microns, then stained with hematoxylin and eosin for histologic study. Where possible in preparing the histological slides the roots of the teeth were oriented so that a mesial-distal section of one root and a buccal-lingual section of the other root of the same tooth were obtained.

The resulting slides were graded for inflammation coronal to the root segment and in the periapical area according to the following scale:

0 No evidence of inflammation

1 Minimal reaction, characterized by a diffuse scattering of inflammatory cells in a prescribed area

2 Moderate reaction -- a mixed inflammatory infiltrate, not well localized

3 Severe reaction characterized by a heavy infiltration, possibly accompanied by resorption of bone.

Bone regeneration coronal to root segment was graded as follows:

0 No evidence of regeneration

1 Minimal bone regeneration

2 Bone regeneration covering at least half the root segment

3 Bone regeneration covering the entire root segment.

RESULTS

Primary closure of the flap resulted in rapid healing of all surgical sites and there was no evidence that the gingiva was perforated by a root segment in any of the specimens. Clinically the ridge contours were normal with two exceptions. In these two specimens the gingiva was slightly elevated. This occurred in a 45 day and 90 day specimen. Histological evaluation revealed cystic areas associated with coronal portions of the roots. These epithelial-lined cysts prevented the formation of osteo-cementum over the coronal surface. In this study the origin of the epithelium was not determined (Figure 1).

None of the experimental roots exhibited resorption. The inflammation associated with the endodontically treated roots appeared to be primarily a response to the excess root canal sealer that was expressed coronally and periapically (Figure 4). Inflammation was evident in all specimens up to 90 days (Figure 2) but the inflammatory infiltrate was minimal in the 120 days specimens (Figure 3). The cellular reaction was predominately a chronic inflammatory response which had walled off the excess root

canal sealer. The scores for inflammation and coronal apposition are shown in Table 1 and 2. New bone formation which extended over more than half of the coronal surface was observed in 62.5% of the submerged roots in spite of the presence of the root canal sealer. The 60 day specimens demonstrated the first complete bone coverage (Figure 5a & b). This specimen is also representative of the formation of a new osteocementum and connective tissue layer separating the coronal dentin from the new bone formation.

None of the control teeth exhibited root resorption or radicular inflammation. Lateral radiographs (Figure 6) did not reveal new alveolar bone over the roots, but mesial-distal radiographs (Figure 7) show the beginning of ossification coronal to the root segment; and new bone was readily observable on histological examination (Figure 8).

DISCUSSION

Dogs were selected for the present study because of their physiological similarity to humans and the comparable reactivity of the periodontal structures (10). Although the experimental time periods were relatively short, Dixon has noted that bony healing occurs two and one-half to three times more rapidly in dogs than in humans (11).

Doing the endodontics and submerging the root at the same time allowed the sealer to express from the coronal portion of the root. At the time of flap closure there was no evidence of sealer on the coronal portion of the root. The elastic rebound from lateral condensation apparently caused the material to be expressed some time after the procedure was completed.

The inflammation surrounding the root canal sealer could have been eliminated by placing an amalgam filling in the canal orifice or by staging the procedure in two steps to allow the sealer to harden. However, in spite of the presence of inflammation, new bone formed coronal to the root in some cases (Figure 2).

From bucco-lingual microscopic sections, it was noted that the lingual alveolar bone was more coronal than the buccal in relationship to the submerged root. It was apparent during the surgical procedure that the radicular bone over the buccal surface was very thin. This accounts for the radiographic appearance of the alveolar crest (Figure 7). In future experiments it may be advisable to bevel the root segment toward the buccal surface to avoid perforation under function. This may explain the perforation which Simon reported on the distal-buccal area in several of his clinical cases (9).

As a result of this study, it appears that submerging roots for preservation of the alveolar ridge has great potential. However, a periodic radiographic follow-up postoperatively is indicated to rule out pathosis such as cysts.

SUMMARY

Mandibular premolars in four dogs were endodontically treated and then totally submerged. Histological and radiographic findings showed that this procedure should be considered as an alternative to extraction of key teeth in an effort to preserve alveolar bone.

1. Periodic follow-up on this procedure should be done to rule out cystic formation.

2. Beveling of the coronal portion to the buccal is advocated to compensate for the thin buccal plate.
3. The procedure should be done in two steps to allow the root canal sealer to set, or an amalgam should be placed over the pulp canal.
4. New cementum and connective tissue will form over the coronal surface separating the dentin from new bone.

TABLE I

New Bone Formation Over Endodontic Submerged Roots

	Scale	0	1	2	3
New Bone					
16 Roots		4	2	3	7

12 showed coronal apposition

TABLE II

Inflammation With Endodontic Submerged Roots

	Scale	0	1	2	3	
Periapical		15	0	1	0	
Pericoronal		7	3	3	3	(3 cysts)

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Figure 1. Epithelial lined cyst (E) in a 90 day specimen associated with the coronal portion of the root (R). The cyst is filled with root canal sealer (S). (40 X)

Figure 2. Specimen at 90 days with partial bone formation (B) coronal to the root. Bone formation on the lingual (L) is higher than on the facial (F) which was characteristic of all specimens sectioned bucco-lingually. (10 X)

Figure 3. Photo micrograph of a 120 day specimen without coronal bone. Particles of the root canal sealer (S) are present with minimal inflammatory infiltrate and new cementum (arrow) is separated by artifact. (40 X)

Figure 4. Multiple apical foramina (AF) common in canine premolars and root canal sealer (S) in the marrow space. (40 X)

Figure 5a. A specimen at 60 days demonstrating complete bone formation over the coronal root surface. (10 X)

Figure 5b. Higher magnification (40 X) of Fig. 5a showing new cementum (C) and connective tissue (CT) continuous with the periodontal ligament separating the coronal dentin and new bone formation.

Figure 6. Lateral radiograph of submerged root in Fig. 2. Radiographic examination shows no coronal bone formation.

Figure 7. Mesial-distal radiograph showing the relative position of the root in relation to the buccal (B) and lingual (L) cortical plates.

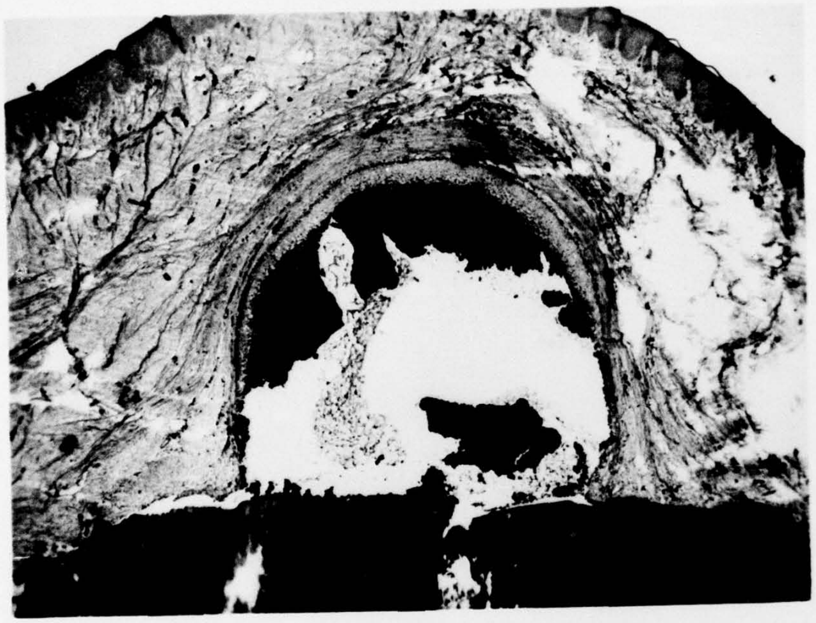

FIGURE 2

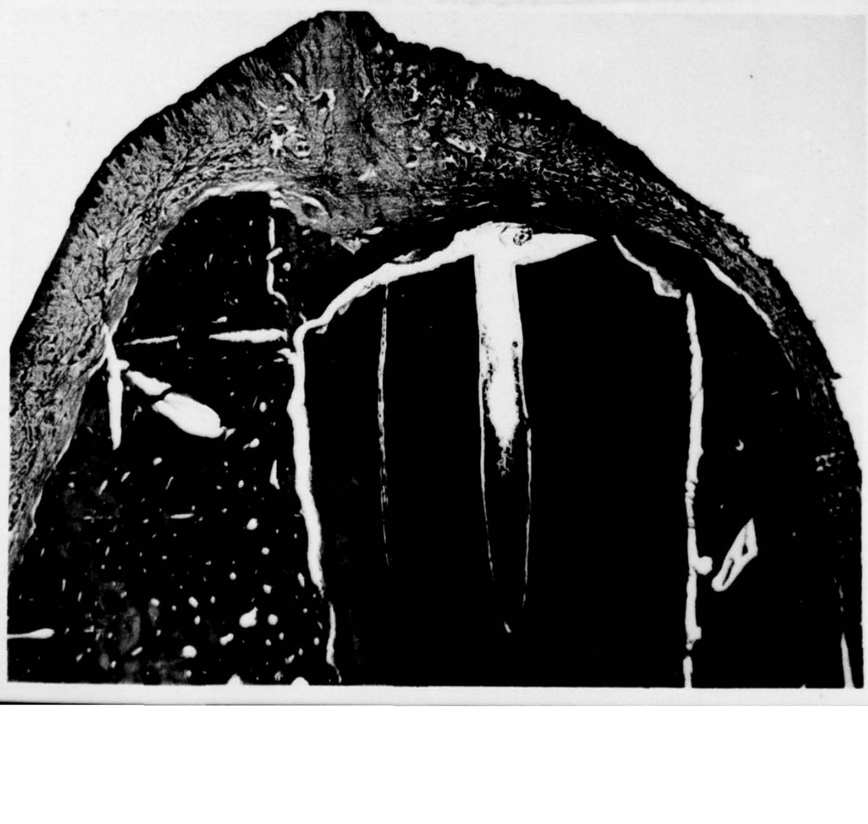

FIGURE 3

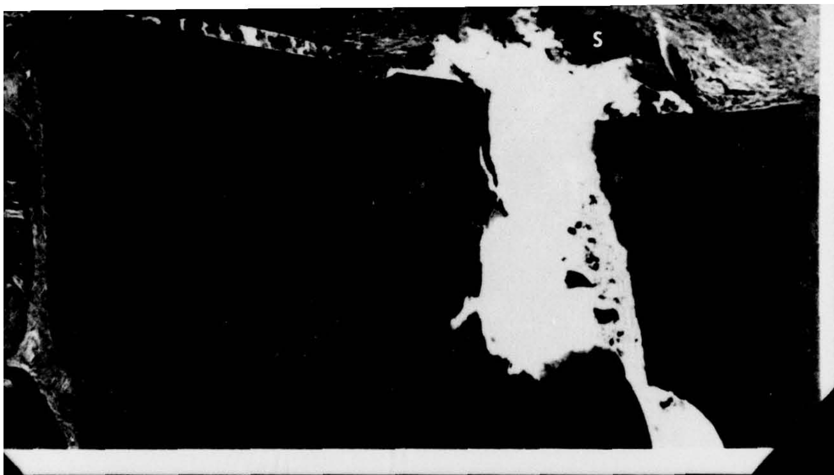

FIGURE 3

FIGURE 4

Figure 5A

Figure 5B

Figure 6

Figure 7